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ARTICLES

Digital Agroecology and the Inhuman: Paradigm Crossroads

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Abstract

A fourth agricultural revolution is pronounced on the strength of new digital technologies entering farming practice. Concerns that, left unchecked, this digital revolution will intensify the problems generated by the third agricultural revolution have led major supranational actors such as the UN and the EU to promote the embedding of state-of-the-art digital technologies within agroecology, a movement that foregrounds the wellbeing of both nature and farmers, drawing on traditional modes of knowledge and practice. The article examines whether this aspiration to combine "the best of both worlds" is feasible at the level of the basic commitments of agroecology and "agromodernism," a term referring collectively to mainstream modes of agriculture that utilise industrial and digital technologies to maximise productivity. The article shows how agroecology and agromodernism constitute contrasting discursive frames and mindsets. At the same time, the article shows that agroecology and agromodernism share an oft-overlooked common ground. Drawing on the work of Martin Heidegger, Jean-François Lyotard and Frédéric Neyrat the article shows that agroecology and agromodernism are constricted by the technoscientific "world-picture," in which the world is infinitely constructible in the hands of the human. The article argues, accordingly, for an alternative, "inhuman" agroecology. Such an agroecology should welcome any technology that resists the totalising tendency of evermore control over the land and foregrounds what exceeds human values and interests.

Keywords Agroecology · Digitalisation · Fourth agricultural revolution · World-picture · The inhuman

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Introduction

Agriculture is undergoing a great transformation, often pronounced the fourth agricultural revolution, driven by technologies such as robotics, variable rate chemical applicators, the Internet of Things, big data, drones and automation (Balafoutis et al., 2020). This transformation is marked by the double pressure of a burgeoning world population and evermore strained life-support systems (Blok, 2017; Stone, 2022). Life-support systems include both wild ecosystems and human food production systems. Protecting wild—yet fragile—ecosystems is a demanding imperative. Even more demanding, however, is making human food production systems thrive: not merely protecting them from the pressures of population growth but ensuring that they continue to facilitate this growth.

In recent years, the enhancement of agroecology, which draws on pre-industrial methods and practices with state-of-the-art digital technologies, has been heralded as the path out of the threefold wicked problem of doing less with more for human food production systems, while fostering biodiversity and natural habitats (De Schutter, 2011; Maurel & Huyghe, 2017; Wezel et al., 2020). However, aside of pragmatic qualms concerning the feasibility of such aspirations and a host of ethical, political and economic barriers, the question emerges whether agroecology and the digital agricultural revolution draw on different paradigms of thought and practice, or whether they are ultimately encompassed by the same "world-picture." In order to engage with the real-world problems that digital agroecology is expected to solve and in order to make sense of the quagmire of normative ethical questions it generates, it is necessary to address first the theoretical question concerning the possibility of a convergence between agroecology and the digital.

To achieve this, the article opens with an outline of agroecology's scope and evolution (Sect. "Introduction"). It proceeds to set into relief the key differences between agroecology and "agromodernism," a term coined in direct parallel to "ecomodernism," to encompass the paradigm guiding the industrial and digital agricultural revolutions. Agroecology and agromodernism are accordingly understood as opposing "frames" of discourse, each generating distinctive sub-frames pertaining to rights, epistemological evidence and the role of technology (Sect. "Agroecology: Scope and Evolution"). As discursive formations and practices, agroecology and agromodernism constitute modes of knowledge and rules of operation that possess a unique historical objectivity (Foucault, 2002, 131). At the same time, the two objective frames correspond to different subjective views. The article undertakes therefore to show the difference between the agroecological and the agromodernist mindsets, which include normative values and beliefs, as well as psycho-affective dispositions (Sect. "Frames and Sub-frames: Agroecology and Agromodernism").

This analysis, drawing directly on existing thematic literature, offers a clear account of the contrasting ways in which agroecology and agromodernism frame the world and condition the human view on it. However, there is a dearth of explicit theoretical reflection concerning the common presuppositions of agroecology and agromodernism. The article supplements this paucity (Sect. "Viewing the Frame: The Agroecological Mind"), by drawing on Martin Heidegger (Sect. 4.1), Jean-François Lyotard (Sect. 4.2) and Frédéric Neyrat (Sect. 4.3), three prominent philosophers

of technology who have sustained an incisive thread of inquiry across the span of the past century on the ways in which technoscience—including industrial-digital agriculture—produces not merely specific objects, but the world as a whole. Their analyses help recognise a specific configuration of the world and of the human, which becomes the converging horizon of both agroecology and agromodernism. The implications of this convergence are far-reaching for agriculture and must be seriously considered if agroecology is not to be co-opted by agromodernism. The article thus closes by drawing out some of these implications and considering the future of an *other*, "inhuman" agroecology (Sect. "The Technoscientific Operation: Constructing the World and the Human"). The term "inhuman" does not refer to mere cruelty or violence, but points beyond all that is pernicious—including cruelty and violence—in the human. This thought-provoking tension at the heart of the term is part of its discursive provenance and scope, as will become apparent in what follows.

Agroecology: Scope and Evolution

If there is any consensus on the semantic and practical scope of agroecology, it amounts to the admission that there are *many* "agroecologies" constantly re-signified and co-produced, from actors with different values, intentions and worldviews (Anderson & Maughan, 2021, p. 2; Loconto & Fouilleux, 2019; Méndez et al., 2012; Rivera-Ferre, 2018). Indeed, agroecology appears to incorporate elements of sustainable agriculture, conservation agriculture and regenerative agriculture, without being strictly identifiable with these movements. Similarly, agroecology often adopts organic or biodynamic practices, without having analogous certification criteria and protocols and the added market value of such labelling.

The principles of agroecology have evolved over time as its scope expanded from field to farm to the whole food system. A milestone was set when the UN's High-Level Panel of Experts (HLPE) for Food Security and Nutrition encapsulated the agroecological approach in thirteen principles: recycling, input reduction, soil health, animal health, biodiversity, synergy, economic diversification, co-creation of knowledge, social values and diets, fairness, connectivity, land and natural governance, and participation (HLPE, 2019). Since then, additional principles have been proposed in literature, aiming to incorporate aspects such as specific practices, socio-cultural dimensions and farming systems (Wezel et al., 2020). One such example (Sect. "Agroecology: Scope and Evolution"), is the addition of the principle of fostering agroecological mindsets (Soini Coe & Coe, 2023).

Agroecology can be moreover understood as a "transdisciplinary approach that embraces science, a set of practices and a social movement" (Wezel et al., 2020). It aims at the creation of sustainable food systems which are beneficial for both local communities and ecosystems. To do so, it leverages natural processes within agro-ecosystems to produce beneficial synergistic relationships and enhance economic sustainability of rural areas. Emphasizing short marketing chains and safe food production methods, agroecology supports smallholder food production methods, food sovereignty, social justice, local identity and indigenous rights concerning seeds and breeds (Wezel et al., 2020).

Agroecology has been routinely dismissed as unrealistic and unviable, with the "feed the world" narrative used to privilege industrial agriculture over ecological production of lower yields. (Anderson & Maughan, 2021, p. 2; cf. Fouilleux et al., 2017, Bellwood-Howard & Ripoll, 2020). Nonetheless, through tireless promotion of its sustainability and social justice merits to policy makers, agroecology has gradually entered the mainstream (Anderson & Maughan, 2021, p. 1). Notwithstanding its promise, however, this development invites fears of co-optation by dominant market and policy agents threatening to rob the movement of its transformative potential (Anderson & Maughan, 2021, p. 2; cf. Levidow et al., 2014; Laforge et al., 2016).

Much of the contestation over the place and future of agroecology centres around innovation. While for many innovation promises a salutary combination of agroecology and technology, others see it as the trojan horse for the co-optation of agroecology. Thematised by Joseph Schumpeter as "doing things differently" (2005, p. 84), innovation has always been integral to the modern developmental paradigm. In recent years, its significance has been encapsulated in OECD's "innovation imperative" (2015), virtually an ultimatum to innovate or perish (Anderson & Maughan, 2021, p. 3).

The dictum echoes the double imperative that drove the third agricultural revolution: a mass utilisation of mechanisation, chemical pesticides and fertilisers on the one hand and of consolidation into ever larger monocultural holdings, on the other. The effects of this development are most tellingly summarised in the fact that while equipment and chemicals became more powerful and the average American farm size increased manyfold during the twentieth century, the reduced numbers of mechanised, large-scale farmers that survived to reap the benefits, earned less than their great-grandparents when adjusting for inflation (Shepard, 2013). Ecosystems fared no better. It is thus unsurprising that the innovation imperative of the fourth agricultural revolution has met with scepticism. Critique points out that claims of social and ecological benefits of technologies are often unsubstantiated (Miles, 2019), while negative impacts, including impacts on labour and agricultural communities are downplayed or altogether ignored (Barrett & Rose, 2021).

Admittedly, numerous attempts have been made to reconceptualise innovation in "responsible" ways, summed up in calls for inclusive innovation, grassroots innovation, social innovation, retro innovation, coupled innovation, as well as agroecological innovation. Nonetheless, innovation remains for many attached to an agromodernist "logic of productivism and accumulation" and thus incompatible with agroecology (Anderson & Maughan, 2021, p. 3).

Frames and Sub-Frames: Agroecology and Agromodernism

An exemplary contestation of agroecology and agromodernism over agricultural policy took place during the consultation process initiated by HLPE in the Committee on World Food Security (CFS) as well as during parallel developments in UN's Food and Agriculture Organization (FAO), which ultimately led to the evocatively titled report "Agroecology and Other Innovations" (HLPE, 2019). To examine this discursive contestation, frame analysis (Snow & Benford, 1992; Steinberg, 1998) provides

invaluable insight into the political-ideological agendas that informed the discussion and positioning of different states (Anderson & Maughan, 2021). For present purposes what matters is the discursive coalescing of all positions into the frames of agroecology and agromodernism, which in view of the role of innovation branched into three further sub-frames concerning i. rights, ii. epistemological evidence and iii. technology. In the following three paragraphs a brief overview of each sub-frame outlines the overall differences of the two main frames.

Firstly, concerning the sub-frame of rights, it became clear that agromodernism considers the choice from a full range of innovative products as a right of the farmers, who are primarily seen as business owners, and the staunch protection of intellectual property as the cornerstone right of technology developers. To these "market" rights, agroecology opposes more fundamental human rights, foregrounding the rights of the most affected and striving for food sovereignty (Loconto & Fouilleux, 2019). This was reflected in HLPE's final report, which after the consultation round promoted human rights into the "basis for ensuring sustainable food systems" (Anderson & Maughan, 2021, p. 11). Although this emphasis was watered down during the implementation stage, it constituted a victory for agroecology, which considers communal modes of living and agricultural knowledge as deserving of equal protection to ecosystems. The above makes clear that socially, as much as ecologically, agroecology is distinct from agromodernist movements such as smart agriculture and sustainable intensification (Anderson & Maughan, 2021, p. 12; Pimbert, 2017).

Secondly, the subframe of evidence revolved around what constitutes reliable agricultural knowledge to justify the adoption of innovation processes. In contrast to well-established metrics for economic and yield performance, agroecology is commonly critiqued as failing to provide measurements for social, cultural, political and ecological outcomes (Anderson & Maughan, 2021, p. 6). Even when the significance of aspects such as the farmers' well-being is acknowledged, the absence of corresponding quantifiable indicators is used to sideline such considerations (Anderson & Maughan, 2021, p. 7). Thus, during the consultation process of the HLPE report opponents of agroecology prioritised the measurable indicators of GDP and farm income, considering farmers primarily as "business owners," rather than "ecological stewards, community members, and knowledge producers" (Anderson & Maughan, 2021, p. 7). In contrast, proponents of agroecology called for critical reflection on the role indicators play in informing policy over more holistic considerations, such as mental health, nutritional value, biodiversity and resilience (Anderson & Maughan, 2021, p. 7).

Finally, the stakes regarding innovation became most apparent in the sub-frame of technology. For agromodernism, innovation is nearly synonymous with technological progress, which conditions in turn social change (Anderson & Maughan, 2021, p. 8). For agroecology, in contrast, innovation is decoupled from technology, as agricultural innovation has been at work for thousands of years, in an ongoing dialogue with social and ecological developments (Anderson & Maughan, 2021, p. 9). A straw man is often made of agroecology's reserve towards technology, as when, for example, the "Cornell Alliance for Science," founded by the Gates Foundation to promote biotechnology in Africa, denigrated agroecology as hostile to science and rationality and as a barrier to the farmers' right to access innovations (Conrow, 2020). Similarly common

is to mobilise agroecology's values against it. Thus, during HLPE's consultation process, traditional agroecological values such as attentiveness to local conditions and resilience to climate change were evoked to promote biotechnological innovation. To that effect, genetic modification, fiercely rejected by agroecology, was asserted as a conducive path towards agroecological goals (Anderson & Maughan, 2021, p. 8). Along the same lines, agromodernism touts technological innovation as being better able to feed the world, make agriculture appealing to a younger demographic and serve a host of other agroecological values. Agroecology responds that the persistent equivocation of the innovation imperative with a moral imperative is sustained by the agromodernist discourse in order to promote top-down, profit-driven technologies with little interest in the flourishing of farmers and ecosystems. In contrast, agroecology considers social innovation as potentially more important than technological innovation, foregrounding farmers as knowledge innovators with a deep understanding of local conditions and in situ practices, from which the aims and modes of innovation must be decided collectively (Anderson & Maughan, 2021, pp. 9–10).

These differences demarcate starkly the two frames. To the agromodernist market rights, agroecology opposes human, farmer and ecosystem rights and food sovereignty. Beyond the agromodernist focus on quantifiable indicators as sole reliable scientific evidence, agroecology commits to the under-researched efficacy of local and traditional modes of knowledge. Over the agromodernist understanding of innovation in exclusively technological terms, agroecology foregrounds the social dimension of innovation. As such, we can observe the normative differences between the values and methods of the two paradigms. While however normative traditions such as deontology and consequentialism would proceed from a prior ethical commitment towards an attempt to determine the most ethical agricultural practice, a discursive frame analysis examines the real-world conditions in which such normative commitments can emerge. As such, agroecology and agromodernism can be equally championed by deontology and consequentialism on the basis of a distinctive framing of the world. Moreover, individuals and institutions may shift their commitment to specific elements of each frame, despite being broadly aligned with either. Such volatility is tampered when discursive embeddedness is coupled with a rigorous subjective mindset, as the section below details.

Viewing the Frame: The Agroecological Mind

Having outlined the *objective* discourse frames of agromodernism and agroecology, it is possible to identify *subjective* differences which lead individuals to espouse each frame. In their research, Eija Soini Coe and Richard Coe adopt the term "mindset" to refer to the normative values, beliefs, motivations, and attitudes that underlie a person's decisions and actions (Soini Coe & Coe, 2023, p. 2). They define mindsets as "deep, assumed patterns of thinking that shape how we make sense of the world" (FrameWork Institute, 2020) and employ the term to encompass the four components that inform the model of justified behaviour. The model, which was developed in the context of education for responsible environmental behaviour entails four types of factors exerting influence: i. motivational (values, beliefs, goals, etc.), ii. social

(norms, roles, dynamics, etc.), iii. contextual (technology, geography, laws, etc.) and finally iv. epistemic, as well as other resources (time, money, power, etc.) (Soini Coe & Coe, 2023, p. 3). Although some of these factors can be also seen as objective discursive conditions, the model of justified behaviour focuses on "mindsets" to analyse intra-personal perspectives also on extra- and inter-personal behavioural influences.

It is worth noting that mindsets have a particular import for normative ethics. Despite not being conceptualised as such within the philosophical tradition, they are readily identifiable with the subjective conditions that enable an individual to espouse distinctive virtues in the rich sense developed within virtue ethics, that is, as ethical traits that determine one's comportment to the world. From within a mindset theory, the normative claims of deontological or consequentialists values are neither a priori, nor universal, but the result of subjectivation, the formation, that is, of an ethical subject. From this perspective, a mindset is the space that a subject occupies in order to relate to a discursive frame.

Accordingly, only a mindset transformation can destabilise "worldviews and frames of reference," which may be precipitated by: "a deeply touching positive experience that allows one to see the world differently; a crisis that tests one's abilities to cope and pushes one to look for alternative ways of thinking; a cumulation of experience that leads to feeling something is wrong" (Soini Coe & Coe, 2023, 4). In total, Soini Coe and Coe identify five core factors specific to the adoption of an agroecological mindset, briefly elaborated in the following paragraph: i. connection with nature, ii. sense of place, iii. individual and group identity, iv. self- and social efficacy as a spillover effect and v. other spillover effects: warm glow and pride.

i. Connection with nature is the principal factor in opposing an agromodernist mindset, where nature figures as a resource to be exploited or a threat to be controlled. Connecting with nature creates and enforces "symbiotic cognitive, affective, and experiential traits that reflect, through consistent attitudes and behaviors, a sustained awareness of the interrelatedness between one's self and the rest of nature" (Zylstra et al., 2014). Thus, beyond and before the normative dimension of moral duty, empathy—adopting nonhuman perspectives—and compassion—instinctively helping nonhumans—fashion an affective disposition of care towards other life forms and ecosystems (Jax et al., 2018). ii. A sense of place, especially when strong enough to inform one's identity, is likely to make one attentive to signs of degradation (Chapin et al., 2012) and thus motivate stewardship of a place. However, unless coupled with other factors, a sense of place may also lend itself to a mindset of agromodernist progress (Soini Coe & Coe, 2023, p. 5). iii. Identification with environmentalist or agroecological groups, including the adoption of such descriptions for oneself, reinforces corresponding values and behaviours (Fritsche et al., 2018). This can forge feedback loops of identification and commitment to an agroecological mindset. iv. Self-efficacy in the sense of the power and freedom to act is also important for putting knowledge and skills to work. Even small achievements—whether individual or collective—can have the "spillover effect" of enhancing a sense of self-efficacy (Soini Coe & Coe, 2023, p. 6). v. Finally, affects such as pride and satisfaction in doing "the right thing," can have spillover effects, consolidating an agroecological ethos. However, such affects may also thwart further action if taken as confirmation of sufficient contribution to the problem (Meijers et al., 2013).

Aside of the fact that some of these factors are non-exclusive to an agroecological mindset and may in isolation veer into an agromodernist worldview, their overall efficacy may also be disputed insofar as their translation into reality appears only possible when environmental and economic motivations are coupled in "win–win practices." It may thus be objected that what matters is not mindsets, but the adoption of practices (Foguesatto et al., 2019, p. 405). However, regardless of whether perfect, "win–win" solutions exist at all, there is little doubt that agroecological mindsets will aid the adoption of agroecological practices and the amplification of the agroecological discourse. To that effect, Soini Coe and Coe propose the addition of fostering such mindsets to the aforementioned thirteen widely accepted agroecological principles (Soini Coe & Coe, 2023, p. 7). What they aspire to, through such *cultivation* of an agroecological mindset, is the transformation of *homo economicus* into *homo ecologicus*, an ethically virtuous person that sympathises, respects and draws inspiration from their experience of nature (Becker, 2006).

There is little doubt that this normative call for a knowledge and management of humanity in the service of nature is preferable to the management of nature in the service of humanity. However, even in this noble aspiration, the welfare of nature is conditional upon the *cultivation*, that is the production and management of ourselves, *as humans* (Massy, 2017; Soini Coe & Coe, 2023, p. 9). This construction of the human as a parallel to the technoscientific construction of the world is where agroecology and agromodernism meet. The following section explores this convergence.

The Technoscientific Operation: Constructing the World and the Human

The fault lines between agroecology and industrial agriculture are now clear, both as objective discursive frames and as subjective mindsets through which these frames are viewed. What must be in turn examined are the tacitly shared presuppositions of the two frames. In order to do so, this section will analyse three interrelated theoretical perspectives on the role of technoscience in the simultaneous configuration of the world and the human. The implications of this exposition for agroecology will be drawn in the subsequent section.

The World as Picture: Heidegger

"Technoscience" refers not merely to the parallel or mutually enhancing operations of technology and science, but to their reciprocal constitution. For Martin Heidegger, modern science is marked by a constant activity, which does not merely aim to understand what is immutable in the world, but to steer the world's becoming, predicting the future and retrodicting the past of all that exists (Heidegger, 2002, p. 63). The complicity of technics and science is here paramount. Modern technics is able to transform the world because it is premised on a scientific apparatus that knows better than ever before, while modern science in turn knows better than ever before because it is premised on a technical apparatus capable of transforming the world. In this cyclical, interminable operation technoscience changes the world it knows and to

that extent knows the world it changes. Research is thus able to bring beings under an unprecedented level of control and, proving itself time and again successful in its results, gradually turns its incessant activity into an end in itself (Heidegger, 2002, p. 74).

For Heidegger the result of this process is twofold: on the one hand, the world—that is, nature as much as history—becomes picture, while on the other, the human becomes subject (Heidegger, 2002, p. 69). Accordingly, a world-picture is not one among many pictures of the world, but rather the world understood *as* picture offering itself to a human subject (Heidegger, 2002, p. 67), which can behold and manipulate it from its own unique viewpoint. Accordingly, a worldview [*Weltanschauung*], is the view of the world-picture that a subject enjoys from their position (Heidegger, 2002, p. 70). This is precisely the correspondence of frames and mindsets elucidated in the preceding analysis. In this development, where the position of the subject can only be occupied by the human, it becomes increasingly impossible to conceive an access to the world that is not anthropological, i.e. premised on the human gaze and evaluated in accordance with the human positionality (Heidegger, 2002, p. 70).

Importantly, in this analysis, there is no ancient or medieval world picture—-the becoming-picture of the world is constitutive of modernity (Heidegger, 2002, p. 68). Technoscience as a uniquely modern phenomenon constructs the world as "picture," that is, "the collective image of representing production," for which the human is the exclusive measure and arbiter (Heidegger, 2002, p. 71). This is precisely because science represents the world in line with the way in which technics produces it. Thus, the world is gradually constructed as the stage on which the human can lead the drama of its self-determination, the sham fulfilment of what the human was bound—freely yet inescapably—to become (Heidegger, 2002, p. 81).

In this process, objects are valued in direct proportion to their serving as props or means the needs of human self-determination and the ongoing transformation of the world into picture. Hence, Heidegger dismisses values as "the powerless and threadbare mask of the objectification of beings, an objectification that has become flat and devoid of background. No one dies for mere values" (Heidegger, 2002, 77). Values cannot proclaim what the world or the human might be, because they are themselves products of the technoscientific "enframing" [*Gestell*]—part, that is, of the transformation of the world into picture and of the human as its master. Accordingly, any normative postulation of values, to the extent that it remains constitutively anthropological, is bound to foreclose the potentialities of both the world and the human.

This diagnosis of technoscience, offered by Heidegger during the years of postwar "reconstruction," an integral part of which was the third agricultural revolution, was further elaborated by Jean-François Lyotard in the latter part of the twentieth century.

Two Senses of the Inhuman: Lyotard

Expanding on Heidegger's diagnosis, Lyotard sees modernity as a relentless striving for efficiency through more reliable, capacious and suppler regulation. It is mediation and thus alienation of the regulated elements—living and non-living alike—that enables the coordination of an ever more *complex* web of modifications and permutations (Lyotard, 1991, p. 6). This process of increasing complexification (faster,

more capable machines, evermore tightly connected and seamlessly coordinated with other faster, more capable machines) has no finality: it is not guided by the plan of a supreme being or by the *telos* of an Idea, such as the emancipation of reason or human freedom, despite the circumstantial use it makes of such normative ethical values and existential principles, leading to the illusion of human self-determination. Importantly, although this logic has no *telos*, its self-contained dynamic has a *limit*: the entropic end of the solar system (Lyotard, 1991, p. 7).

This "pure" event is critical for Lyotard, because it poses a hard limit to the understanding of thought as a uniquely human quest of interminable progress and progression (Lyotard, 1991, p. 9). While "human death is included in the life of human mind," solar death implicates the eclipse of all thought, not merely provisionally or temporarily, but definitively. Thinking the solar death means thinking the constitutive disjunction of thought from reality—a thought beyond what classical philosophy can conceptualise. Technoscience is, however, prepared to venture beyond the horizon of the human project by dissociating thinking from its material conditions. For Lyotard, "this and this alone is what's at stake today in technical and scientific research in every field from dietetics […] to particle physics […]" (Lyotard, 1991, p. 12).

However, solar death is arguably neither the ultimate nor the sole limit of the human project: at one end, an interstellar human emigration is a staple of technoscientific fiction; at the other end, the imminent threat of a collapse of the material conditions of all life presents itself with relentless force. It is, indeed, this threat of ecologic collapse that informs the debate around agroecology and invites the present revisiting of Lyotard, by postulating a limit that is neither merely biological, nor—contra Lyotard—cosmic; it is, rather, a uniquely *terrestrial* limit. The earth as a planetary body is not in danger; the earth as the locus of life and the totality of its conditions, is.

The role of technology in the face of this terrestrial limit is critical. For Lyotard, as for André Leroi-Ghouran before him and Bernard Stiegler after, technology antecedes the emergence of the human. Importantly, Lyotard understands technology in cybernetic terms, i.e. as the capacity of any material system to retain and employ information in order to impact the environment and procure the desired results, ultimately aiding the system's perpetuation. In this sense, all life is technological. The human partakes in the technology of life but amplifies its complexity through the creation of symbolic informational systems. Such systems are semantically and syntactically *arbitrary* and thus detachable from their material conditions ("a rose by any other name would smell as sweet" in the famous Shakespeare line) as well as *recursive*, affording the reconfiguration of their operational rules in the face of novel input (more complex and capable grammatical structures and elaborate vocabularies to accommodate new linguistic needs) (Lyotard, 1991, p. 12). Digital technologies raise this human capacity for complexity to a new order of magnitude, as machine recursivity becomes ever more efficient at incorporating data to improve its structural conditions of operation. Thus, machines outdo humans in the capacity that they, amongst all life, excelled. For Lyotard this process leads inexorably to "Cartesian modernism," the abandonment of life's material corporeality, as matter becomes ultimately a hindrance to thought, "its inert mass, stupidity" (Lyotard, 1991, p. 38).

However, for Lyotard the embodiment of human—and more generally biological—intelligence is not an unfortunate limitation, but what makes every intelligence unique. Following Hubert Dreyfus, Lyotard notes that human thought is not premised on a binary code, but operates, always imprecisely, through intuition and hypothesis in an ambiguous environment, collecting "data" which have not been pre-configured according to a protocol of readability. This collection process is not unwaveringly focused, but also lateral and thus open to the marginal (Lyotard, 1991, p. 15). Embodied thought does not transcribe the perceptible world onto an external recording substrate but rather finds itself enmeshed in a world that composes, sustains and determines it (Lyotard, 1991, p. 17). Since the perceivable appears always inexhaustible in the past, present and future, embodied thought remains phenomenologically open. The body, in all its aspects, including sexual difference, is an inextinguishable source, generating infinite thought, infinite action, infinite memory. Out of these lineaments corporeal affect becomes imagination.

For Lyotard, however, human history is an unfaltering attempt to overcome the universal conditions that compose yet at the same time limit living intelligence. Education offers a micrography of this process as children, perpetually riveted by physical frailty and intellectual naivety are ushered into the secure community of adult reason (Lyotard, 1991, pp. 3–4). This constitutes a passage from the exemplary "humanity" of childhood, strongly attached to corporeal affect and thus imagination, into the space of "inhuman" reason, the abstract informational space into which the human as a technological-symbolic species has a privileged access among all life.

The "age of reason" encapsulate thus in developmental terms what modern technoscience effects historically: the intensification and autonomisation of inhuman reason which turns intelligence against its constitutively human embodiment. This historic process is still incomplete. For Lyotard its completion would require machines to think, or rather imagine, which in turn would require that the information that constitutes their contact point with the world be construed not as "data," that is, as "given," already established facts about the world, but as an open letting-arrive of the indeterminable (Lyotard, 1991, p. 18). Perhaps the future will be able to create incorporeal systems able to welcome indetermination. At the present juncture of terrestrial collapse, however, this dream of technoscientific disembodiment generates and sustains merely an inhumanity "of development" (Lyotard, 1991, p. 2). This is an inhumane and dehumanising inhumanity which strives to not to exceed, but to disintegrate the conditions of human existence.

Before examining the implications of this inhuman tendency of technoscientific reason for agriculture (Sect. "The Technoscientific Operation: Constructing the World and the Human"), it is worth adding a twenty-first century inflection to the preceding analysis, through Frédéric Neyrat's notion of the "unconstructible."

The Unconstructible: Neyrat

For Neyrat, modern technoscience advances a double operation: first, nature is construed as *external* to the human and subjected to a quantifying-codifying rationality and second, nature is appropriated as a factor of production. This "organisation of

nature" by technoscience means that the latter is not merely operating *on* nature, but rather that nature is working *for* technoscience (Neyrat, 2021, pp. 3–4).

What makes the world "inhuman" and life well-neigh unliveable, is precisely that the world is "human, all too human" (Neyrat, 2021, pp. 8–9). As such, Neyrat's diagnosis, linking Heidegger to Lyotard is that we suffer not due to a deficit, but an excess of humanity; what is deficient is the "inhuman" element, "that which does not ask to be built, that which does not ask to become, that which does not beg to be connected, or even to be empowered" (Neyrat, 2021, p. 9). In effect, Neyrat proposes that one sense of Lyotard's "inhuman" be turned against the other. To combat the ubiquitous inhumane cruelty towards all life, including other humans, one must resist the production of the world, one must become "inhuman" (Neyrat, 2021, p. 8).

Neyrat considers the "inhuman" more apt than the "nonhuman" for a conceptual resistance to modernity. For while the "nonhuman" refers to all forms of intelligence and life beside the human, the "inhuman" is found "at the core of every human being as what refuses to be shaped and reshaped" (Neyrat, 2021, p. 8). This is for Neyrat Lyotard's lesson, exposing in the human an unconstructible dimension which resists the humanist and post-humanist forces of effective constructivism (Neyrat, 2021, p. 3), which mobilise human indetermination to stage the heroic drama of human self-determination. The inhuman is thus neither an external disruptive event (e.g. a comet or earthquake), nor an "ancestral" monstrous force composing reality (e.g. planetary homeostasis driving extinctions), but a constitutive, abiding dimension of the human, amounting to a certain negation of agency, a certain inoperativity, the capacity to contemplate nothingness (Neyrat, 2021, pp. 7–8). This capacity affords the human access to "mystery," not what is extraneous to knowledge, but what resists knowledge and our desire to know and possess (Coccia, 2024, p. 37).

Allowing a space for the inhuman is for Neyrat "one of the challenges of the ecopolitics to come" (Neyrat, 2021, p. 8). This requires opening up a third domain between the familiar antinomy or dilemma between merging and segregating nature and society. For Neyrat, this dilemma is premised on the abstraction of nature by effective constructivism, which facilitates the conceptual incorporation of nature in technoscientific circuits of production, as well as its apparent opposite—the banishment of nature from all that is relevant to human reality (Neyrat, 2021, p. 4). The same abstraction sees the nonhuman solely in "negotiation" with the human, foreclosing the possibility of its independence (Neyrat, 2021, pp. 5–7). What the inhuman makes apparent is that the human does not exist "in" nature, just like nature cannot be encompassed "within" the technoscientific frame which transforms the world into a picture. Rather, the human exists *with* and depends *on* the nonhuman which does not depend on it in turn; there is no symmetry between the human and the nonhuman (Neyrat, 2021, p. 5).

Having examined Lyotard's inflection of Heidegger's and Lyotard's operation of modern technoscience, it is now possible appraise some of the implications of the preceding elaboration for the future of agriculture.

Implications: Inhuman Agroecologies

The preceding analysis demarcated the pervasive differences of agroecology and agromodernism, both as objective discursive frames (Sect. "Agroecology: Scope and Evolution") and as subjective mindsets (Sect. "Frames and Sub-frames: Agroecology and Agromodernism"). In its light, the integration of the two may appear well-neigh inconceivable. Indeed, suspicion remains entrenched on both sides. However, the fact that major international actors, such as the UN and the EU view the rapprochement of agroecology and agromodernism as desirable, if not vital, for the future of the earth's life support systems, is not mere wishful thinking. What the theoretical analysis of the technoscientific operation (Sect. "Viewing the Frame: The Agroecological Mind") makes apparent, is that the humanism of agromodernism has a correlative in agroecology.

In the wake of Heidegger (Sect. 4.1), it appears difficult to imagine a position outside the totalising technoscientific "en-framing" [*Gestell*] of the world as a picture for the perusal of the human subject. In turn, the human subject, produced in parallel with the world it views, functions as the agent of technoscience in the construction of the world. Rather than being inconsistent with pluralism, it is this singular human "point of view" that forms the origin of the modern proliferation of worldviews. It is also from this point of view that diverse and often clashing normative values proliferate—as they nonetheless remain tethered to the human.

Already the first agricultural revolution that ushered in the Neolithic age constituted a radical world-constructing project. Human populations boomed along with new transmissible and non-transmissible diseases, as well as wealth and power inequalities, while natural ecosystems suffered (Kohler et al., 2017; Larsen, 2006). The second and third revolutions that industrialised agriculture, intensified this transformation. Today, the burden to furnish proof that digitalisation heralds a better future lies with the brokers of the fourth agriculture revolution. The growing call for the adoption of alternative modes of agriculture, such as agroecology, shows that the largest supranational institutions are unprepared to entrust the future of life support systems to the unchecked efficacy of digitalisation.

However, the exposition has shown (Sects. "Agroecology: Scope and Evolution" and "Frames and Sub-frames: Agroecology and Agromodernism") that the human remains decisive to both the agroecological discursive frame and the agroecological mindset. Even when cast as the steward rather than the exploiter of nature, the human remains protagonist, director and stage designer at once. Thus Lyotard (Sect. 4.2) and Neyrat (Sect. 4.3) turn to the inhuman. Lyotard finds in the human an inhuman dimension that is as vital as it is dangerous. Insofar as inhuman reason opens a space of imagination not fully determined by, yet springing forth from corporeality, the inhuman remains the flower of human intelligence; becoming, however, increasingly autonomous through modern technoscience, the inhuman leads to widespread dehumanisation. Lyotard's confessional admonition is telling: "to believe, as happened to me, that the first [form of inhumanity] can take over from the second, give it expression, is a mistake" (Lyotard, 1991, p. 2). The inhumanity of technoscience is not operating in the interest of the innermost inhumanity of the human. Resistance to the technoscientific in all its forms, including agromodernism, pitching, that is, the inhu-

man against the inhumane is for Lyotard the sole meaningful political gesture in late modernity. This is a normative precept that does not readily fall within the existing boundaries of ethically normative theories.

Neyrat develops this diagnosis, foregrounding the notion of in/constructability. The inhuman is here that dimension of the human that does not strive to construct the world. The inhuman thus keeps open a space where the nonhuman is allowed to break through, establish itself and thrive. This may support the decolonisation of nature, which for Neyrat consists in de-growth and deceleration (Neyrat, 2021, p. 6) but may also entail re-wilding and re-generation. Under these headings, strong movements coalesce today with well-articulated policy demands. Importantly, such demands may be made with either the human or the inhuman in sight. Rewilding, for example, may proceed from a "human" vantage point, insofar as it offers "ecosystem services," that is, helps the human economy, mental wellbeing and ultimately survival of humans. As such, rewilding may or may not prove compatible with specific configurations of classical normative models, like utilitarianism. However, rewilding may also be undertaken in the service of the inhuman. This will entail a recognition of the irreducible significance of the living and non-living beings that compose the rewilded space, as well as of the significance of the rewilded space that opens up *within* the human through such a process—a space of imagination (cf. Monbiot, 2013).

Rewilding and agroecology are not commonly twined, but the inhuman makes it difficult to ignore their nexus. This is certainly a policy matter, as it is a matter of grassroot movements and agroecological practice. At every turn, the inhuman generates a shift of emphasis and perspective. Importantly, emancipation cannot be left to the emancipators but must first and foremost be driven by the emancipated. It is the agroecologists who must drive policy.

However, as the beginning of the analysis noted (Sect. "Introduction"), the space of agroecology is fragmented. Some agroecologists will remain bound to humanist constructability. Nonetheless, a space of inhuman agroecologies can be claimed. From it, policy and practice can shift. If, for example, the majority of current technological innovations aim at furthering efficiency gains such as workload reduction, rather than benefiting the environment (Gabriel & Gandorfer, 2023, p. 78), agroecology must labour towards creating meaningful practices that are not merely comfortable, convenient and conducive to the human. Masanobu Fukuoka's *One-Straw Revolution*—one of the most influential agroecological texts *avant la lettre*—details what an agricultural practice that foregrounds the unconstructible, looks like (Fukuoka, 1978[1975]). Fukuoka calls this "do-nothing" agriculture, yet those who came to live, study and work with him were surprised to discover that his methods involve gruelling labour. The point is not to facilitate idleness or leisure, but to develop an agricultural disposition marked by reserve and circumspection, allowing nature to have the first and last word.

Fukuoka's vision on agriculture may be contested. If, however, agriculture is to be genuinely ecological, it must be able to discover and respect within and without the human, something that is altogether *other* and may potentially turn against the human. As the most prominent agroecologist, Stephen R Gliessman, observes: "farming with nature rather than against her is a foundational component of how we as agroecologists think" (Gliessman, 2022, p. 163). Working *with* nature means

discovering the unconstructible part in it. By the same token, it means discovering the inhuman part in oneself.

Conclusion

The preceding analysis showed the clash of agromodernist and agroecological discursive frames and mindsets, while also showing the common ground they share insofar as they are implicated in the technoscientific enframing of the world, a world which is offered to a human subject to construct. This analysis is not an abstruse theoretical exercise; its stakes are as pressing as they are high. Lyotard's summary is on point (Lyotard, 1991, pp. 53–54):

> When you can simulate in vitro the explosion of the sun or the fertilization or gestation of a living creature, you have to decide what you want. And we just don't know. This foreclosure of ends […] has been dressed up in all sorts of disguises: destination of man, progress, enlightenment, emancipation, happiness. Today this foreclosure appears naked. More knowledge and power, yes — but why, no.

As received humanist values seem no longer able to sustain the human project, let alone afford it clear orientation, attending to the inhuman may be the only salutary path. Agroecology is one of the few practices where care for the inhuman can find clear expression and make a decisive difference. Its adoption of new digital technologies cannot be a one-way street into which agroecology is coerced by "pragmatic" policies. Such technologies should not merely provide more "knowledge and power" to farmers, but serve to attune their attentiveness to the inhuman, foregrounding the flourishing of the unconstructible within and beyond the farm.

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References

Anderson, C. R., & Maughan, C. (2021). 'The innovation imperative': The struggle over agroecology in the international food policy arena. *Frontiers in Sustainable Food Systems*. https://doi.org/10.3389/fsufs.2021.619185

Balafoutis, A. T., Evert, F. K. V., & Fountas, S. (2020). Smart farming technology trends: Economic and environmental effects, labor impact, and adoption readiness. *Agronomy, 10*, Article 743. https://doi.org/10.3390/agronomy10050743

Barrett, H., & Rose, D. C. (2021). Perceptions of the fourth agricultural revolution: What's in, what's out, and what consequences are anticipated? *Sociologia Ruralis, 62*(2), 1–28. https://doi.org/10.1111/soru.12324

Becker, C. (2006). The human actor in ecological economics: Philosophical approach and research perspectives. *Ecological Economics, 60*(1), 17–23. https://doi.org/10.1016/j.ecolecon.2005.12.016

Bellwood-Howard, I., & Ripoll, S. (2020). Divergent understandings of agroecology in the era of the African green revolution. *Outlook on Agriculture, 49*, 103–110. https://doi.org/10.1177/0030727020930353

Blok, V. (2017). Earthing technology: Towards an eco-centric concept of biomimetic technologies in the Anthropocene. *Techné: Research in Philosophy and Technology, 21*(2/3), 127–149. https://doi.org/10.5840/techne201752363

Chapin, F. S., Mark, A. F., Mitchell, R. A., & Dickinson, K. J. (2012). Design principles for social-ecological transformation toward sustainability: Lessons from New Zealand sense of place. *Ecosphere, 3*(5), 40. https://doi.org/10.1890/ES12-00009.1

Coccia, E. (2024). *Philosophy of the home: Domestic space and happiness*. Penguin.

Conrow, J. (2020). Agroecology must be based in reality, not romanticism. *Cornell Alliance Sci.* Available at: https://allianceforscience.cornell.edu/blog/2020/10/agroecology-must-be-based-in-reality-notromanticism-panelists-agree/

Foguesatto, C. R., Borges, J. A. R., & Machado, J. A. D. (2019). Farmers' typologies regarding environmental values and climate change: Evidence from southern Brazil. *Journal of Cleaner Production, 232*, 400–407. https://doi.org/10.1016/j.jclepro.2019.05.275

Foucault, M. (2002). *Archaeology of knowledge*. Routledge.

Fouilleux, E., Bricas, N., & Alpha, A. (2017). 'Feeding 9 billion people': Global food security debates and the productionist trap. *Journal of European Public Policy, 24*(11), 1658–1677. https://doi.org/10.1080/13501763.2017.1334084

Fritsche, I., Barth, M., Jugert, P., Masson, T., & Reese, G. (2018). A social identity model of pro-environmental action (SIMPEA). *Psychological Review, 125*(2), 245–269. https://doi.org/10.1037/rev0000090

Fukuoka, M. (1978). *The one-straw revolution*. Rodale Press.

Gabriel, A., & Gandorfer, M. (2023). Adoption of digital technologies in agriculture: An inventory in a European small-scale farming region. *Precision Agriculture, 24*, 68–91. https://doi.org/10.1007/s11119-022-09931-1

Gliessman, S. (2022). Balancing nature and agriculture. *Agroecology and Sustainable Food Systems, 46*(2), 163–164. https://doi.org/10.1080/21683565.2022.2009171

Heidegger, M. (2002). The age of the world picture. *Off the beaten track* (pp. 57–85). Cambridge University Press.

Agroecological and other innovative approaches for sustainable agriculture and food systems that enhance food security and nutrition. Rome: CFS high level panel of experts.

FrameWork Institute. 2020. *Mindset shifts: What are they? Why do they matter? How do they happen?* FrameWork Institute.

Jax, K., Calestani, M., Chan, K. M., Eser, U., Keune, H., et al. (2018). Caring for nature matters: A relational approach for understanding nature's contributions to human. *Current Opinion in Environmental Sustainability, 35*, 22–29. https://doi.org/10.1016/j.cosust.2018.10.009

Kohler, T. A., Smith, M. E., Bogaard, A., et al. (2017). Greater post-neolithic wealth disparities in Eurasia than in North America and Mesoamerica. *Nature, 551*(7682), 619–622.

Laforge, J. M. L., Anderson, C. R., & McLachlan, S. M. (2016). Governments, grassroots, and the struggle for local food systems: Containing, coopting, contesting and collaborating. *Agriculture and Human Values, 34*, 663–681. https://doi.org/10.1007/s10460-016-9765-5

Larsen, C. S. (2006). The agricultural revolution as environmental catastrophe: Implications for health and lifestyle in the holocene. *Quaternary International, 150*(1), 12–20. https://doi.org/10.1016/j.quaint.2006.01.004

Levidow, L., Pimbert, M., & Vanloqueren, G. (2014). Agroecological research: Conforming—or transforming the dominant agro-food regime? *Agroecology and Sustainable Food Systems, 38*(10), 1127–1155. https://doi.org/10.1080/21683565.2014.951459

Loconto, A. M., & Fouilleux, E. (2019). Defining agroecology. *The International Journal of Sociology of Agriculture and Food, 25*, 116–137. https://doi.org/10.48416/ijsaf.v25i2.27

Lyotard, J.-F. (1991). *The inhuman: reflections on time*. Stanford University Press.

Massy, C. (2017). *Call of the reed warbler*. Chelsea Green Publishing.

Maurel, V. B., & Huyghe, C. (2017). Putting agricultural equipment and digital technologies at the cutting edge of agroecology. *Ocl, 24*, Article D307. https://doi.org/10.1051/ocl/2017028

Meijers, M. H. C., Noordewier, M. K., & Avramova, Y. R. (2013). *I just recycled, in Encouraging sustainable behavior: Psychology and the environment*. Taylor and Francis.

Méndez, V. E., Bacon, C. M., & Cohen, R. (2012). Agroecology as a transdisciplinary, participatory, and action-oriented approach. *Agroecology and Sustainable Food Systems, 37*(1), 3–18. https://doi.org/10.1080/10440046.2012.736926

Miles, C. (2019). The combine will tell the truth: On precision agriculture and algorithmic rationality. *Big Data & Society, 6*(1), 1–12. https://doi.org/10.1177/2053951719849444

Monbiot, G. (2013). *Feral: Searching for enchantment on the frontiers of rewilding*. Penguin Books.

Neyrat, F. (2021). Dismantling the world: The capitalocene, effective constructivism, and the inhuman. *DasQuestões, 13*(1), 2–11.

OECD. (2015). *The innovation imperative: contributing to productivity, growth and well-being*. OECD.

Pimbert, M. (2017). Agroecology as an alternative vision to conventional development and climate-smart agriculture. *Development (Cambridge, England), 58*, 286–298. https://doi.org/10.1057/s41301-016-0013-5

Rivera-Ferre, M. G. (2018). The resignification process of agroecology: Competing narratives from governments, civil society and intergovernmental organizations. *Agroecology and Sustainable Food Systems, 42*(6), 666–685. https://doi.org/10.1080/21683565.2018.1437498

Schumpeter, J. A. (2005). *Business Cycles: a theoretical, historical, and statistical analysis of the capitalist process*. Martino Publishing.

De Schutter, O. (2011). Agroecology and the right to food. *Rep. Present. 16th Sess. U. N. Hum. Rights Counc. AHRC1649 8*.

Shepard, M. (2013). *Restoration agriculture: real world permaculture for farmers*. Acres U.S.A., Inc.

Snow, D. A., & Benford, R. D. (1992). Master frames and cycles of protest. In A. D. Morris & C. M. Mueller (Eds.), *Frontiers in social movement theory* (pp. 133–155). Yale University Press.

Soini Coe, E., & Coe, R. (2023). Agroecological transitions in the mind. *Elementa: Science of the Anthropocene*. https://doi.org/10.1525/elementa.2022.00026

Steinberg, M. W. (1998). Tilting the frame: Considerations on collective action framing from a discursive turn. *Theory and Society, 27*, 845–872. https://doi.org/10.1023/A:1006975321345

Stone, G. D. (2022). *The agricultural dilemma: How not to feed the world*. Routledge. https://doi.org/10.4324/9781003286257

Wezel, A., Herren, B. G., Kerr, R. B., Barrios, E., Gonçalves, A. L. R., & Sinclair, F. (2020). Agroecological principles and elements and their implications for transitioning to sustainable food systems. *Agronomy for Sustainable Development, 40*, 1–13. https://doi.org/10.1007/s13593-020-00646-z

Zylstra, M. J., Knight, A. T., Esler, K. J., & Le Grange, L. L. (2014). Connectedness as a core conservation concern: An interdisciplinary review of theory and a call for practice. *Springer Science Reviews, 2*, 119–143. https://doi.org/10.1007/s40362-014-0021-3